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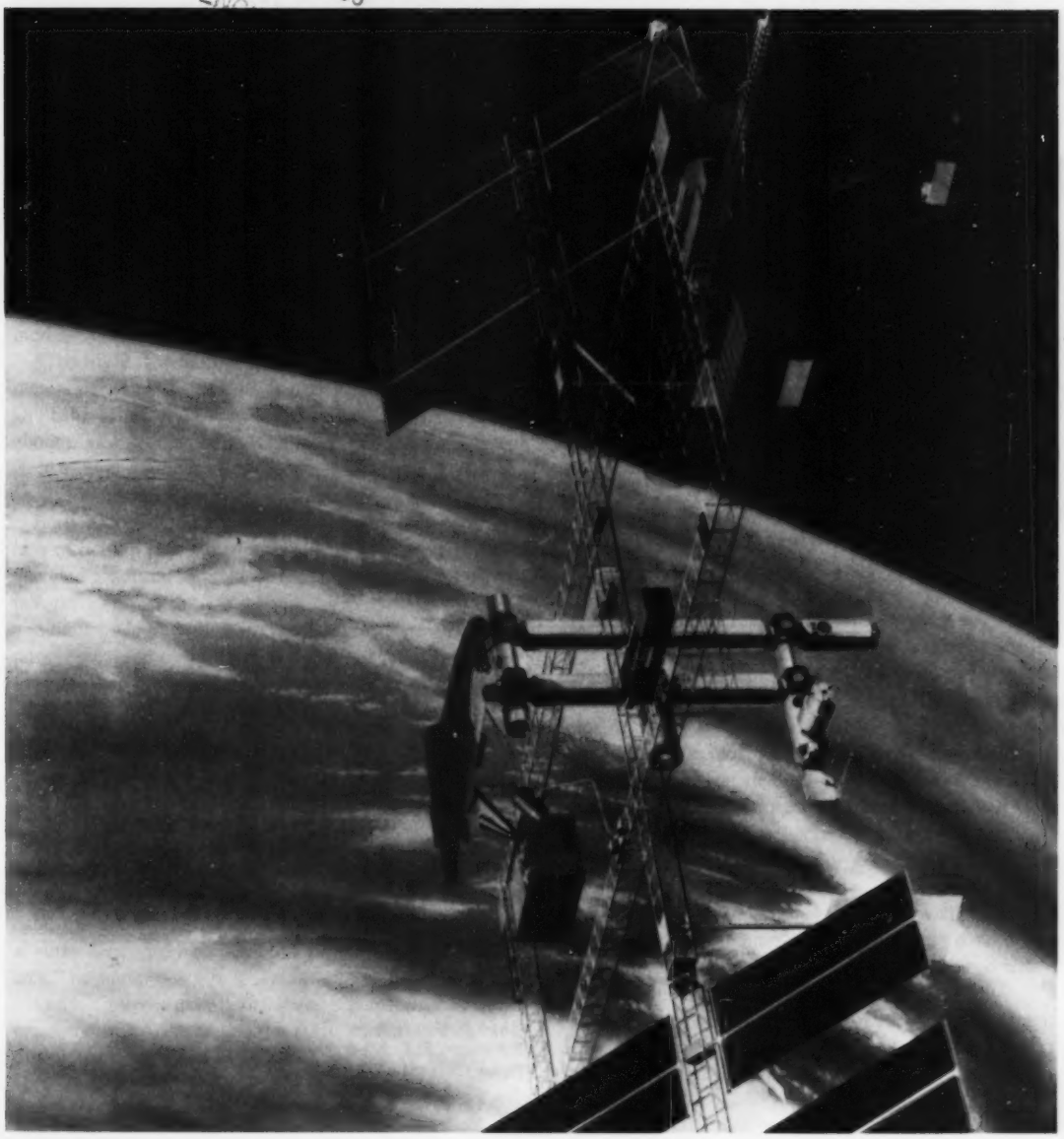

About The Cover

This is the most detailed artist rendering of the "dual keel" concept of the Space Station being developed. NASA has adopted this modified version of the "power tower" concept as the new reference configuration for the definition and preliminary design phase of the Space Station program. Many of the basic Station designs will be finalized in the next several months. This concept was done by NASA's Johnson Space Center, Houston, Tx.

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Voyager 2 Encounters New Worlds

NASA's scientific ambassador to distant worlds, Voyager 2, unlocked many secrets surrounding the strange planet Uranus in January, as the spacecraft bolted through the Uranian system.

The dependable spacecraft performed almost flawlessly, executing the complicated commands sent by engineers and scientists 1.8 billion miles from Earth. Voyager 2 returned a variety of images and an amazing amount of information that will keep scientists occupied for years.

Voyager 2 surprised scientists with new findings and new objects in the Uranian system, including 10 additional satellites and at least two more dark rings circling the bluish planet.

Uranus is now known to have at least 15 moons and at least 11 rings.

Before the encounter, scientists did not know Uranus' rotation rate, now determined to be once every 17 hours.

Scientists also found high winds in at least three different locations in the atmosphere, winds that travel in the same direction as the planet rotates. Wind speeds increase poleward of the planet's equatorial regions.

"The highest winds we measured were about 130 meters per second, near 40 degrees south latitude," said Dr. Ellis Miner, Assistant Project Scientist. "That is about 300 miles per hour. The lowest winds we detected were around 15 meters per second, which would translate about 35 miles per hour."

Early reports had indicated an unusually high proportion of helium in Uranus' atmosphere. But Voyager 2 detected a normal amount of the inert gas—about 12 percent.

Scientists learned of a high atmospheric haze layer, possibly caused by methane ice. Another form of haze, or what Voyager scientists described as photochemical "smog," was detected at the south pole apparently hiding the clouds below.

"We found a magnetic field at Uranus—strangely tilted 55 degrees with respect to the rotation axis." Miner said. "The field strength at the surface is slightly less than Earth's and slightly more than Saturn's."

Uranus' elusive dark rings revealed several surprises.

"Besides the two new rings found in the imaging data, the photopolarimeter detected 10 possible additional rings. They may be complete rings or perhaps just arcs," he said.

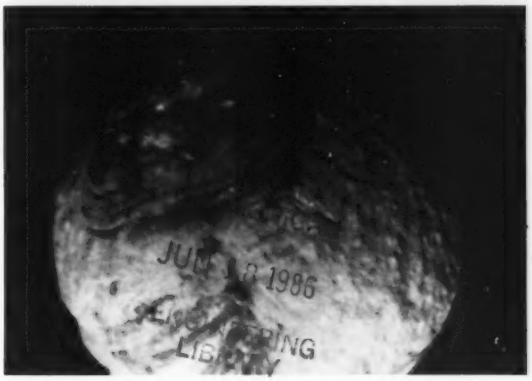
Quite different than the rings of Saturn, Uranus' rings are composed of large boulder-sized particles, with most of the mass contained in chunks three feet or larger. Saturn's rings, by comparison, are composed of bright grain-sized particles.

"This doesn't mean there are no smaller particles in Uranus' rings. We have seen evidence of very diffuse tiny particles extending over most of the known ring system," Miner explained.

The moons of Uranus captured much attention during the encounter. The 10 new moons range in size from 10 miles in diameter to 110 miles in diameter. Voyager team members continue to look for additional moons called "shepherding" moons—that herd particles into rings around the planet. Only two of the new moons can be considered shepherds, flanking the epsilon ring.

Images returned of the five previously known moons—Miranda, Ariel, Umbriel, Titania and Oberon—delighted and mystified scientists. There was a wide variety of surface features on these satellites.

"Miranda is particularly interesting," Miner said.



A Voyager 2 image of Miranda from a distance of 91,000 miles. Note the system of ridges, valleys and impact craters that abuts the terrain.

This tiny moon roughly 300 miles in diameter—is one of the most bizarre worlds in the solar system. It has an astonishing array of geologic features: mountains and valleys, an area of grooved terrain that resembles a race track and other areas with sinuous scarps, probably fault lines. The most predominant feature was a "Y" shaped, or chevron, feature—noticeable long before Voyager 2 made its closest approach to the small sphere. Miranda is also packed with impact craters—implying the once geologically active satellite has been dormant for some time.

Umbriel also puzzled scientists. Sandwiched between the other active satellites, this moon is very dark, very old and seemingly inactive. Its surface is scarred with large impact craters about 60 to 120 miles wide.

Long valleys etch the surface of Ariel, some of them filled with more recent bright-colored material. Titania revealed deep fault lines running across the

entire surface of the satellite, in some cases at least 1,000 miles long. Oberon's icy surface boasted a large mountain and hundreds of impact craters surrounded by bright rays. One impact crater contained a bright central peak and a floor partially covered with very dark material.

"For four of the five major moons Ariel, Umbriel, Titania and Oberon we have preliminary density estimates. Those estimates imply that the moons are about 50 percent ice and 50 percent rock," Miner said.

Even at the low light levels present at Uranus, images of the satellites were amazingly clear with no evidence of blurring, this due to painstaking measures taken by the Voyager spacecraft team to reduce imaging smear.

A detailed image of Ariel taken from a distance of about 80,000 miles. Numerous valleys and fault scarps crisscross the highly pitted terrain.

"The spacecraft team and the sequence team went through a Herculean effort to provide us with target-motion compensation for all five of the known moons," Miner said. "The images returned were essentially free of any type of smear."

"The engineers also reprogrammed our flight data computer not only to give us more useful data modes but also to compress the imaging data prior to its transmission to Earth."

The Deep Space Network (DSN) was also instrumental in the mission's success. The DSN just converted to a new hardware and software system and even though not all of the problems had been worked out, almost all of the important data were returned to scientists at NASA's Jet Propulsion Laboratory, Pasadena, Calif.

"It's a source of pride to all of us that things worked as well as they did," Miner said. "I think they worked well because of the Voyager team. They looked for every possibility and designed the observations to be as fault-free as possible.

NASA Predicts Revolutionary Advances In Aircraft Performance

Advances through aeronautical research and technology development have brought aviation to the threshold of a new era in air transport performance, according to a NASA report—an era that could introduce a new generation of aircraft with improvements as important as the introduction of jet transports more than 30 years ago.

The report, prepared by Gerald G. Kayten, NASA Headquarters, Washington, D.C., and Cornelius Driver and Domenic J. Maglieri, NASA's Langley Research Center, Hampton, Va., asserts that the basis for this dramatic development is not a specific breakthrough in any single technology. They say it is an assortment of advances in a wide variety of technical areas. Some of them are quantum jumps, others are relatively minor refinements.

"Most of the separate advances offer sufficient benefits in their own right," say the three authors, "so they will eventually be incorporated to some extent as individual features of derivative or conventional new aircraft. When combined and properly blended together, however, they can become the ingredients of revolutionary new designs with the potential for spectacular improvements in air transportation."

The report says that several example aircraft, based on very preliminary design studies, reveal two additional points:

- New subsonic transport design approaches may feature unusual configurations with important performance and economic advantages that must not be rejected simply because they do not look like today's aircraft.
- Technology benefits applied to supersonic design are so potent and the growing need for highly productive transportation between far-distant population centers is so apparent, that serious reconsideration must be given to a concerted effort to be ready for a new supersonic transport generation.

In spite of severe financial hardships faced by several major airlines and a number of smaller new ones, Kayten, Driver and Maglieri report in "The Revolutionary Impact of Evolving Aeronautical Technologies" that the potential economic benefits of emerging technologies and intensified competition will make new transport developments inevitable. Concern that air traffic may not grow fast enough to pay for these developments is dismissed by quoting forecasts of a two-and-one-half-times increase in passenger miles in the next 20 years and a tripling of commercial transports in operation by the end of the century.

"Projected increases in population, commerce and

tourism are expected to result in significant increases in long-distance transoceanic travel between various points in the developed and developing countries. To put it simply, it appears that if a greatly improved new fleet of transport aircraft can be developed in the next decade, a greatly enlarged traveling public will use it," the authors write.

NASA and its industry and university partners are developing technology to make possible the predicted revolution in aeronautics. Dr. John Martin, NASA's former Associate Administrator for Aeronautics and Space Technology, reported to a Senate subcommittee that, "Today, the technology opportunities in aeronautics are probably greater than at any other time in our lifetime."

NASA, he said, is committed to a central role in the technology development required for superior U.S. civil and military aircraft because key elements of national and economic security are linked to preminence in aeronautics.

From new propulsion options and new structures and materials to computer-aided controls and displays, the technology is advancing rapidly. Even the study of aerodynamics, the granddaddy of all aeronautical disciplines, is promising bold new concepts for improved aircraft of the future.

A report commissioned by the Office of the White House Science Advisor identified three key national goals in aeronautics:

1. Subsonic Goal: To build trans-century renewal
2. Supersonic Goal: To attain long-distance efficiency
3. Transatmospheric Goal: To secure future options

Twin-fuselage transports like this artist's concept promise important aerodynamic and structural efficiencies over comparable single-fuselage aircraft.

The subsonic goal, in part, envisions technology for an entirely new generation of fuel-efficient, affordable U.S. aircraft operating in a modernized national airspace system. The supersonic goal, in part, develops pacing technologies for sustained supersonic cruise capability and enables linking the farthest reaches of the Pacific Rim in 4 to 5 hours. The transatmospheric goal pursues research to routinely cruise and maneuver into and out of Earth's atmosphere with takeoff and landing from conventional runways.

Technologies for the first two goals are outlined in the NASA "Impact" report. Technology realization will speed the nation into a new era in air transports.

The Subsonic Revolution

To passengers, the airliner of the next century could be very different in efficiency and performance, but look much the same as today's transport.

Ironically, the most obvious difference might be a return to propellers—improving the turboprop of the 1950's and 1960's to tap its great potential for fuel efficiency. Working with the propeller industry, NASA's Lewis Research Center, Cleveland, OH., has taken advantage of several technology advances in propeller blade structures and aerodynamics to dramatically reshape the propeller.

Mounted at the rear of the plane, the turboprop's huge, highly-swept blades might be in counter-rotating pairs on each side of the fuselage. Each propeller may have as many as eight or ten blades. This new system would carry people and cargo using 20 to 30 percent less fuel while matching the jet speed and cabin comfort of modern turbofan-powered aircraft.

Elements of NASA's advanced turboprop program include the "propfan test assessment" program to flight test a large-scale, single-rotation propeller in 1986. In one of several tests planned by NASA and industry in the next few years, a three-quarter scale, 9-foot diameter propeller will be put on an existing business jet to answer questions about structural integrity and noise levels.

More subtle innovations will include new materials and new structural concepts, called composites, to make air transports of the 21st Century lighter and tougher. Thin filaments of graphite and epoxy could be wound in a continuous strand to form an airplane fuselage, much like rocket cases are manufactured. The layers could be part of a structural "sandwich" that would weigh 25 percent less than an aluminum-skinned and reinforced counterpart. Wing weight could be reduced even more through a combination of parallel advances.

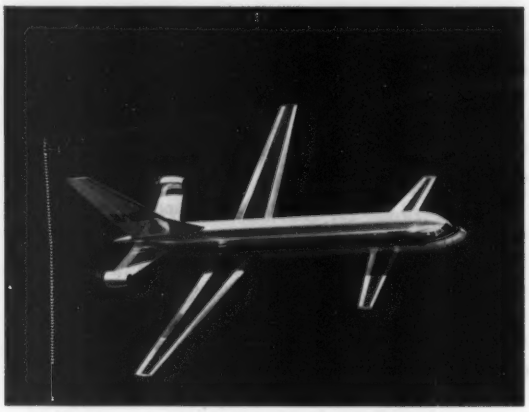
The net payoff would be significant. A further contribution to fuel efficiency would be made, of course, and

manufacturing costs would be reduced—parts count in an aircraft fuselage would be cut in half.

NASA hs invested about $160 million since initiating a cooperative program with industry in composite primary aircraft structures technology. Laboratory and flight tests have proven the toughness of large-scale advanced composite structures, successfully meeting damage tolerance and other criteria. A major program milestone was reached when five new transports were fitted with composite tail assemblies, marking the first use of composites for an essential transport structure. The aircraft are now in commercial service.

NASA ended the program a few months ago, having provided a data base which industry can now apply to new products. The agency will continue fundamental research into composite materials and structural concepts.

Passengers may look out their windows in the year 2005 and see long and slender wings, with aerodynamically-shaped cross sections for optional lift. The correct airfoil shape, combined with a perfectly smooth, wave-free skin, could result in "natural laminar air flow," where thin layers of air slide over the wing surface with a minimum of skin friction drag. The wings also might have nearly microscopic perforations or slots allowing air closest to the wing to be pumped from the surface—again to reduce drag, but this time, for active laminar air flow control.



Subsonic transports of the 21st century might resemble this fuel-efficient turboprop concept, complete with forward wing surfaces called canards and slender aft-located main wings.

The larger surface of the fuselage, where turbulent air flow is unavoidable, might have tiny grooves called "riblets" parallel to the direction of travel to reduce turbulent air drag. The grooves could be made of self-adhesive tape and applied directly to the aircraft surface. With the discovery of riblet-like scales on the skins of fast-swimming sharks, nature has confirmed the results of NASA research and wind tunnel tests.

Aerodynamic discoveries may be accelerated when a powerful, new supercomputer and simulation complex is fully operational at NASA's Ames Research Center, Mountain View, Calif. Soon to be the most advanced computational system in the world for aeronautical research and development, the Numerical Aerodynamic Simulation (NAS) Program will perform 1 billion computations per second by late 1987—more than three times faster than the previous generation of supercomputers. The computational fluid dynamics work, possible with NAS, will help researchers simulate conditions and flow phenomena difficult to measure physically, like the flows of air through the internal passages of turbine engines.

Passengers of the 21st Century might be surprised the first time they look into the cockpit to see computer terminals and television-like screens in place of the usual myriad of knobs, switches, indicators and electromechanical displays. Gone may be the traditional columns and wheels, replaced by less bulky side stick controllers. This "desk top" cockpit design would use the latest improvements in electronics to help the pilot and first officer become effective managers of increasingly complex aircraft flight systems.

The NASA study looked at combining these and other emerging technologies in a 200-passenger, 525 mph (Mach 0.78) airplane and concluded that the advantages are striking when compared with an advanced aluminum airplane with turbulent flow and turbofan engines. According to the report, airplane weight would be reduced 30 percent and fuel efficiency would be more than doubled as a result of the combined technologies. At these values, the report goes on, "the airplane is more efficient than trains and buses in fuel consumption."

Radically new airplanes that would look and be very different promise even greater improvements if the aircraft industry, the public and financial institutions are willing to accept wide departures from conventional aircraft. Such a synergistic combination would result in maximum benefit of technologies expected by the end of the century.

A twin-fuselage airliner, for example, promises several advantages. Each of its two aircraft bodies (separated by a central wing section) could be the same size and construction as single-body transports made by the same company, allowing significant savings through a "family concept" of aircraft. Preliminary NASA studies show that a twin-body arrangement would be more aerodynamically efficient for the same payload and have much improved structural efficiency compared with an equivalent single-fuselage 400-passenger airplane.

The Supersonic Revolution

The revolution in technology improvements for subsonic air transports is well under way and will make the air transport of the 21st Century dramatically more economical—but that alone will not provide the spark to complete the revolution. When jet engine and swept-wing technologies combined in the jet era to entice people to fly more than ever before, it was the promise of shorter trip times that helped the revolution succeed. Flying faster, today, means flying beyond the speed of sound, beyond the capability of subsonic transports where special challenges remain.

NASA, which never totally stopped research and development of supersonic cruise technology, sees tremendous benefits in a renewed national commitment to SST.

"We should seriously consider a technology development program which would lead to an advanced SST early in the next century," advised Richard H. Petersen, Director, Langley Research Center, in a keynote address to a leading aerospace institute last year.

"Advanced technology, coupled with better understanding of the environmental issues and the changes which have occurred in the world travel market, has radically changed the prospects for an advanced supersonic transport," Petersen added.

Such a transport will eventually materialize, according to the Kayten, Driver and Maglieri report, as a result of the influence of the same technologies emerging for subsonic airplanes, the great strides made in military programs and the quarter century of focussed effort in supersonic cruise research that began with basic studies in the 1950's.

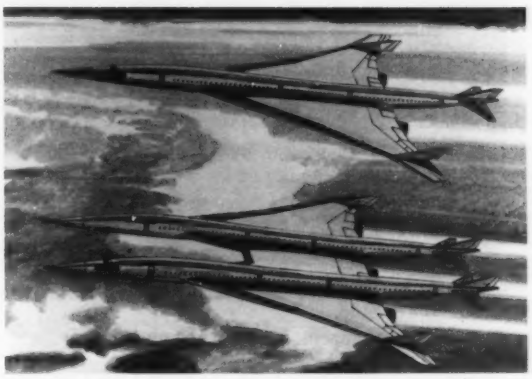
The new-generation supersonic transport can be economically attractive when compared with new-generation subsonic transports and with old generation supersonic transports, the report points out. Significant technological progress has taken place in the 20 years since the British-French Concorde and the ill-fated U.S. SST were designed. Further potential advances in aerodynamics, propulsion, and structural and systems weight, combined properly, suggest a vehicle with four times the fuel efficiency of Concorde.

This is possible, in part, because of the $1 billion invested by the United States in the national SST program between 1963 and 1971 when the program was cancelled. It is also possible because of a follow-on effort by NASA to solve the technological problems identified in the U.S. program (until funding was stopped for this, too, in 1981) and by the international experience gained after more than 80,000 hours of flight at twice the speed of sound (about 1,350 mph) in the Concorde.

A U.S. supersonic transport could be designed in the early 1990's with the range to fly directly across the Pacific Ocean at nearly three times the speed of sound, if the critical technologies are worked hard in the next few years. Trans-Atlantic flights could originate directly from the U.S. interior, initially flying subsonically.

At about 1,800 mph, a flight from Los Angeles to Toyko would take just over 3 hours in an advanced supersonic transport—compared with 10 hours subsonically. The ticket would cost the same or slightly more than for the equivalent subsonic flight, according to estimates by Kayten, Driver and Maglieri.

A supersonic transport inevitably costs more and has higher fuel consumption than an equivalent subsonic transport, but the key to keeping the fare down is offsetting these penalties by tremendous productivity. Because of its speed, a supersonic transport can generate many more passenger miles over its lifetime than a comparable-size subsonic transport.



A second generation SST could carry 250 passengers across the Pacific Ocean in little more than 3 hours.

The potential of developing technologies must first be realized to make sustained supersonic cruise at these speeds practical. An advanced SST has special technology needs in propulsion and heat-resistant materials. The achievement of supersonic laminar air flow control would further enhance the SST's performance by increasing aerodynamic efficiency.

Much effort was devoted by NASA in the 1970's to developing propulsion technologies for "variable cycle" engines, a promising concept for combining the supersonic cruise performance of a straight turbojet and the low-noise takeoff performance of today's subsonic turbofan. SST engine designers in the 1960's were forced to compromise performance, both at low speed and at supersonic cruise, to get a workable design, Petersen said in his address, but variable cycle engines can be matched to these demands with greatly reduced compromises and penalties.

Environmental concerns had a major role in the cancellation of the U.S. SST. The three prime concerns were airport-community noise, depletion of Earth's ozone layer in the upper atmosphere and sonic booms. In the 1970's, NASA gave each of these considerable attention and research. Technological advancements have done much to minimize jet noise, and the effect on upper atmospheric ozone was found to be insignificant. Sonic boom, however, continues to be a problem. Researchers are discovering how to reduce the intensity of sonic booms, but more work is needed before the next generation SST can fly supersonically over land.

"What can we now achieve with the technologies that we have developed in the last 20 years of hard work?" asked Petersen. "Recent preliminary design studies suggest an exciting two-engine, 250-passenger, advanced supersonic transport. It is an arrow (highly swept) wing configuration designed to cruise at Mach 2.7. It uses a superplastically formed and diffusion bonded titanium metal matrix structure and incorporates an advanced two-person cockpit, a sophisticated flight management system and fly-by-wire electronic control system.

"Clearly, there is no comparison between the potential performance of an advanced supersonic transport and the first generation SST's designed in the 1960's. We have roughly doubled both the payload and the range."

Beyond the year 2000, projected increases in population, commerce and tourism are expected to result in major increases in long-distance travel, particularly for Pacific crossings. A demand for 500 or more advanced SST's is conceivable.

Before all this happens, industry and government must be convinced to start investing in the plane's development, estimated to cost between $3 billion and $5 billion. An intensive, five-year, $500-million preliminary research program is what is needed now, according to Petersen.

In an article entitled "Future Developments Toward a Second-Generation SST," published in *World Aerospace Profile* in February 1986, Driver writes, "The advanced SST is inevitable. The technology is at hand and is bound to come by the early 1990's. The major remaining question is what country or countries will lead the supersonic revolution!"

President Awards Ames Chief 1986 National Medal of Science

Bernard M. Oliver, Chief of the Search for Extraterrestrial Intelligence (SETI) program at NASA's Ames Research Center, Mountain View, Calif., received the National Medal of Science from President Reagan.

Dr. Oliver's citation commends him "for translating the most profound discoveries of physics and communication science into the electrical, radio, and computer systems which have improved our culture and the lives of all Americans."

"It's in recognition of a lifetime of accomplishment in science," added Mary Gant of the White House Science Office.

Nineteen other scientists also received the award—the nation's highest scientific honor.

The National Medal of Science was established by Congress in 1959 to honor up to twenty Americans each year for achievements in science. According to the enacting legislation, the President awards the medal based on "the total impact of an individual's work on the present state of the physical, biological, mathematical, engineering, behavioral, or social sciences."

Oliver has contributed to many important fields since receiving his doctorate in electrical engineering at the California Institute of Technology in 1940.

While working for Bell Telephone Laboratories from 1940 to 1952, Oliver helped establish standards for television transmission, worked on automatic radar tracking, and advocated pulse-code modulation for the telephone system, a method of transmission that was later adopted by the telephone company.

Oliver joined Hewlett-Packard Company as director and later vice-president of research and development; he was named director of the corporation in 1973.

While at Hewlett-Packard, Oliver developed the first hand-held calculator with scientific functions, which appeared on store shelves in 1972 with a price tag of $395. His other innovations include the first programmable desk-top calculator with scientific functions.

After Oliver retired from Hewlett-Packard in 1983, NASA-Ames chose him to head its SETI program office. With antennas now used for radio astronomy and for Jet Propulsion Laboratory's Deep Space Network, the SETI program will scan the stars for radio signals that may be transmitted by intelligent extraterrestrial beings.

NASA and You

The Satellite Doctor

Henry Clay Hoffman believe that satellites can have as many lives as a cat. Like a family vet who nurses sick pets back to health, Hoffman rejuvenates NASA "birds" again and again and again.

Some say the slightly-built, dark-haired engineer thinks that dying satellites can be resurrected and that, like a witch doctor, he breathes life into ailing spacecraft with a special engineering mumbo-jumbo using arcane phrases like "poles and zeros, nulls and stability factors."

No matter how one looks at Hoffman, however, he is—by any measure—a unique individual whose name undoubtedly will go down in history as one of the greatest "fixers" of satellites the world has ever known.

Hoffman is Chief of the Guidance and Control Branch of the Space Technology Division at Goddard. He has been responsible for the technical development of spacecraft and launch vehicle stabilization, guidance and control subsystems since 1962. He also has developed a team of Goddard engineers who under his leadership, work as a team to keep spacecraft alive and well.

He has been instrumental in bringing back to life a number of satellites which without him, probably would have failed at a tremendous loss both in dollars and in science.

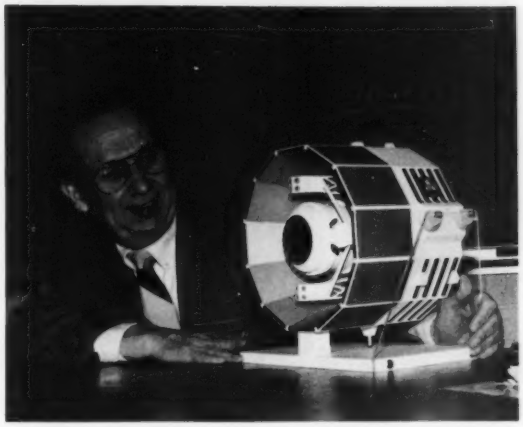
While he is widely respected for his technical expertise in designing and developing attitude control systems for a number of major NASA spacecraft, this enthusiastic engineer's recognition stretches far beyond the NASA arena. Over the last few years, he has gained an international reputation for his efforts of taking the "wobble" out of satellites that have lost their control systems hundreds and even thousands of miles above Earth.

On two occasions in 1980 and again in 1984, Hoffman played a major role in the re-stabilization of the Solar Maximum Mission (SMM) satellite, masterfully plucking it from doom with a touch of space magic that has brought him honors and fame the world over. Hoffman's leadership in developing the new control laws which stabilized Solar Max led directly to the historic first recovery and repair of a spacecraft in space.

When the stability of any NASA satellite is threatened, the first person to get a panic call for help is this Goddard engineer. Hoffman is always ready to jump in when his expertise is needed.

That was the case with the Tracking and Data Relay Satellite (TDRS) in 1983. It failed to reach geosynchronous orbit when its booster rocket failed shortly after deployment from the Space Shuttle. Hoffman made major contributions to a NASA-industry team that over a 59-day period, nursed the satellite more than 8,000 miles into its proper orbit using only six of the spacecrafts' thimble-sized thrusters. The achievement is considered one of the outstanding engineering feats in space history.

Hoffman thrives on problem solving. Perhaps this is why the recovery of the International Ultraviolet Explorer (IUE) is not only his most recent success story but also his project.



Henry Hoffman views a scale model of the IUE spacecraft.

Hoffman led a team of Goddard engineers who saved this 128 million dollar observatory after one of its three remaining gyros failed. Their highly unconventional and ingenious plan substituted the spacecraft's sunsensor for the missing gyro.

Observatory controllers placed the spacecraft in a yaw-spin configuration or "safe hold made" before feeding the plan to the IUE's onboard computers.

Hoffman currently is developing a standby plan to be implemented when another gyro fails.

Hoffman is the recipient of many awards including Goddard's 1985 Moe I. Shneebaum Memorial Award which is presented for outstanding accomplishments in the field of engineering. NASA awarded him with two Exceptional Service Medals, one in 1974 and the other in 1983. He won the NASA Exceptional Engineering Achievement Medal in 1984.

The National Society of Professional Engineers cited the TDRS rescue team, of which Hoffman was a key member, for one of the 10 most outstanding engineering

achievements of 1983. Aviation Week and Space Technology cited his role as one of the top achievements of 1984.

In addition to the significant role that Hoffman has played in Goddard missions, he has applied his expertise to international and commercial programs such as Helios (German); Eole (French); INSAT (India); San Marco and LAGEOS II (Italian); Intasat (Spanish); the UK Series (British); Swedish sounding rockets; the Active Magnetospheric Tracer Explorers (AMPTE), and many of the Intelsat series of commercial communication satellites.

Much of his success is owed to the engineers with whom he works, according to Hoffman.

"I work with a top level team," he said. "We've been working together for a long time. Three of the people I work with now were already here when I came to Goddard in 1962."

When asked about retirement, Hoffman smiled and said: "I can stir a lot of pots and get my fingers into a lot of programs here at Goddard. I couldn't conceive of any other job in the world that would be as interesting or as challenging as the one I have here."

NASA Scientists Seek Cause Of East Coast Cyclones

Scientists from NASA's Goddard Space Flight Center, Greenbelt, Md., plus 25 other federal and private laboratories mounted the largest field experiment of its type, in an attempt to understand winter storms that annually wreak more than a billion dollars worth of havoc along the East Coast.

The experiment named GALE (Genesis of Atlantic Lows Experiment) funded and led by the National Science Foundation, was conducted over a 2-month period that ended March 15.

Scientists were concentrating their efforts on the coastal regions of North and South Carolina where winter storms, commonly known as cyclones, develop rapidly and move northward. The storms often have been hard to predict for many reasons including inadequate understanding of their processes and poor observation especially over the ocean.

According to Dr. Louis Uccellini, of the Severe Storms Branch, Laboratory for Atmospheres at Goddard, "The goal was to obtain observations of these storms and ultimately develop a numerical storm model for the region that will enable researchers to predict the birth of storms, their subsequent movement and their intensities."

The Severe Storms Branch, along with scientists from Goddard's Laboratory for Oceans, studied specific storm phenomena as part of a national team of research groups attempting to develop a total picture of cyclone behavior. The national team included some 200 scientists, engineers and technicians.

The NASA scientists studied two areas of storm behavior which traditionally have been simulated by numerical models rather than by eyewitness accounts or direct measurements.

Uccellini's group analyzed upper atmosphere conditions using temperature, moisture and wind sounding balloons launched every 3 hours from 40 sites administered by the National Oceanic and Atmospheric Administration (NOAA) throughout the Eastern third of the United States. The group also collected data from NASA's Nimbus 7 satellite, which carried an observing instrument called the Total Ozone Mapping System (TOMS). The TOMS provided a picture of the structure of the troposphere (ground level to 6 miles altitude) and the stratosphere (above 6 miles) as reflected by varying concentrations of ozone, one of the constituents of air.

Uccellini explained, "The data showed us how air masses were drawn into the troposphere from the stratosphere, possibly contributing to the development of cyclones. When the stratosphere descends in local spots the fast moving stratospheric air can rapidly tumble downward, setting up a circulation pattern that has great potential for developing a spin. But just how and when that happens is hard to predict and its interaction with lower tropospheric waves over the ocean is difficult to observe."

Scientists from the Laboratory for Oceans group, led by Dr. S. Harvey Melfi, associate chief for programs, studied how conditions at sea level influence storm development. The group flew five scheduled airplane flights to chart how moisture rises into the atmosphere from the ocean between storms.

"During the lulls between storms, very cold air from the arctic sweeps in behind the outgoing low-pressure zones off the Carolinas and comes into contact with the warm coastal water. At those times, a tremendous amount of heat and moisture is released into the lowest layer of the atmosphere, setting the stage for rapid development of another storm," Melfi stated. "We want to know how the moisture transfer takes place, and why some cyclones suddenly develop very quickly and begin dumping snow while others fizzle out," he concluded.

To study the moisture transfer into the atmosphere, flights were conducted over the ocean storm region in a four-engine Electra from NASA's Wallops Flight Facility on Virginia's Eastern Shore. On board was a combined laser/telescope called Lidar which detects salt spray and

aerosols rising from the ocean into the air. As the laser is fired over the sea surface, the rising salt and dust particles are illuminated and can be observed by the telescope, providing measurements of the rising moisture and also its convection patterns.

Data on moisture in the atmosphere also was collected by NASA's high-altitude ER-2 aircraft carrying microwave radiometers able to detect water vapor and cloud liquid water content. The ER-2 airplane is managed by NASA's Ames Research Center, Mountain View, Calif.

NASA's Federal Engineer of the Year

James E. Kingsbury, Director, Space and Engineering, George C. Marshall Space Flight Center, Huntsville, Ala., was honored February 19 as NASA's Engineer of the Year during the National Society of Professional Engineers award banquet.

Mr. Kingsbury was a major influence in the successful development of the Saturn launch vehicles, and his extraordinary technical and managerial skills were invaluable during the design and development of the major Space Shuttle systems. He also directed the systems engineering task for the 1983 flight of Spacelab I, which resulted in major accomplishments in science and engineering.

Pictured from left to right are National Society of Professional Engineers President-elect Mr. Kuranz, Mr. Kingsbury, and NASA's Chief Engineer Dr. Silveira.

NASA Agrees To Canadian Space Station Hardware Proposal

NASA agreed to a proposal by the Ministry of State for Science and Technology of Canada to perform preliminary design of a Mobile Servicing Center during the remaining phase of the Space Station definition and preliminary design study (Phase B).

Canadian Prime Minister Brian Mulroney announced Canada's decision to proceed with Space Station participation March 18 during a visit to Washington, D.C. to meet with President Reagan.

The Mobile Servicing Center would be a multi-purpose structure equipped with manipulator arms that would be used to help assemble and maintain the Space Station, as well as help upkeep instruments and experiments mounted on the Station's framework.

The agreement between NASA Acting Administrator Dr. William Graham and Canadian Minister of State for Science and Technology Mr. Frank Oberle, marks an important milestone in the process of defining the function and content of hardware for the Space Station that could be provided by international partners.

The Mobile Servicing Center would consist of a base structure with accommodations for payloads, orbital replacement units, utilities and thermal control. Included with this structure would be the Space Station Remote Manipulator System, end-effectors and servicing tools, and special-purpose dextrous manipulators. As an adjunct to the design of a Mobile Servicing Center, Canada also will perform preliminary design on a fixed servicing site which could be used for working on attached payloads and for storing the spare parts carried on the Mobile Servicing Center.

NASA is conducting preliminary design of hardware for servicing sites on the Space Station. NASA also is conducting preliminary design of a flight telerobotic system which employs a dextrous robotic device for working on spacecraft brought to the Station, or for in-situ servicing, repair and refurbishment of remote spacecraft when used as the "smart front-end" of an Orbital Maneuvering System.

This agreement covers design work during the remainder of the Phase B period, which extends through January 1987. A formal decision by Canada to proceed with the development, operation and utilization of the Space Station will be subject to successful completion of Phase B activities, to the satisfactory negotiation of an arrangement for cooperation, and to the availability of funds.

NASA expects to complete the definition portion of the Phase B effort in the next few weeks. This will lead to the selection of a baseline configuration for the permanently manned Space Station, which will guide preliminary design activities for the remainder of the Phase B program. Space Station development is scheduled to begin in mid-1987 and lead to an initial orbiting capability by 1994.

NASA Schedules Five Expendable Launches For 1986

Five satellites will be placed in Earth orbit by NASA in 1986 using Delta and Atlas Centaur rockets. The launches include two Geosynchronous Operational Environmental Satellites (GOES), two Fleet Satellite Communication (FLTSATCOM) satellites and one Department of Defense mission.

The GOES satellites for the National Oceanic and Atmospheric Administration (NOAA) are an improved version of geostationary meteorological spacecraft providing day and night pictures as well as vertical temperature and moisture data in the atmosphere for use in weather forecasting. They also will collect and relay data from remote automated facilities including ocean buoys, rain gauges, river and tide gauges and automated weather-observing facilities. In addition, the satellites detect solar activity that impacts radio transmissions among other environmental effects.

The FLTSATCOM satellites are a second generation series of geostationary communications spacecraft to be shared by the Navy, Air Force and other entities within the Department of Defense, including the Strategic Air Command and the Presidential Command Network. They provide secure communications between land-based facilities and ships, submarines and aircraft. The Navy is the lead agency for the FLTSATCOM series.

Delta 180 will launch a mission for the Department of Defense which will support the research and development effort for the Strategic Defense Initiative.

Delta rockets are launched under the management of a joint NASA/McDonnell Douglas Astronautics launch team. Atlas Centaurs (AC) are managed by a joint NASA/General Dynamics Convair launch team.

Schedule Of Expendable Launches From Cape Canaveral

May 1	Delta 178	Complex 17	Pad A	GOES-G
May 22	AC-66	Complex 36	Pad B	FLTSATCOM-F
Aug. 14	Delta 180	Complex 17	Pad B	DOD
Oct. 9	Delta 179	Complex 17	Pad A	GOES-H
Nov. 6	AC-67	Complex 36	Pad B	FLTSATCOM-G

Heard From Around The World

Britain—The HOTOL spaceplane concept being developed by British Aerospace Space and Communications Division received funding of 3 million dollars from the UK Department of Trade and Industry, which will be matched dollar for dollar by British Aerospace themselves and by Rolls-Royce, whose Derby subsidiary is working on proof-of-concept studies on HOTOL's revolutionary air-breathing rocket engine.

HOTOL is competing with France's Hermes mini-Shuttle project to become Europe's next-generation satellite-launching vehicle.

Due to pressure of work at British Aerospace's Stevenage facility, the HOTOL program is to be centered on the company's Military Aircraft Division at Warton, near Preston in Lancashire.

NASA Scientist Awarded International Astronomy Medal

Dr. Albert Boggess, Space Telescope project scientist for operations at NASA's Goddard Space Flight Center, Greenbelt, Md., was named the co-recipient of the Herschel Medal, awarded by the Council of the Royal Astronomical Society of the United Kingdom.

Boggess was cited for his contribution to the success of the International Ultraviolet Explorer (IUE) satellite. He served as IUE project scientist from the development phase, through the first several years of operation, including the January 1978 launch of the spacecraft.

Professor R. Wilson, University of London, was the co-awardee of the Herschel Medal, which is awarded once every 3 years for exceptional contributions to observational astronomy.

The IUE is continuing a 10-month program to study Comet Halley's evolution as it approaches and then recedes from the sun. The research centers on the comet's physical and chemical properties.

The satellite maintains a quasi-geosynchronous orbit over the Atlantic Ocean, which allows it to be in contact with ground observation sites at Goddard and Villafranca, Spain, an observing site near Madrid.

The IUE is a joint project of NASA, the European Space Agency and Britain's Science Research Council.

NASA To Participate In High Energy Solar Physics Program

NASA released an announcement of opportunity for U.S. scientists to participate in the High Energy Solar Physics program (HESP), sponsored by the Institute of Space and Astronautical Science (ISAS) of Japan. The HESP mission is planned for launch into low-Earth orbit in the early 1990s.

The goal of the HESP mission is to advance the understanding of high energy phenomena on the sun through X-ray and gamma ray observations taken by a carefully coordinated set of instruments carried on a spacecraft intended to be built and launched by ISAS. HESP will continue the systematic study of high energy solar processes started by the NASA Solar Maximum Mission and the ISAS Hinotori mission, both orbited in the early 1980s during the last epoch of maximum solar activity.

ISAS invited U.S. scientists' participation through NASA, under terms of the U.S.-Japan agreement on cooperation in research and development. This particular announcement of opportunity limits participation, both principal investigators and co-investigators, to scientists from U.S. institutions.

The solicitation by NASA for participation in the HESP mission was for a single scientific investigation from a small team of U.S. scientists who will analyze data derived from the HESP payload for the study and understanding of both energetic and quiet solar phenomena. The successful U.S. investigation team will be expected to help design and construct a soft X-ray telescope for the HESP payload, in conjunction with Japanese HESP scientists.

While ISAS anticipates final approval and funding for the HESP mission, such approval is not final as of the date of the announcement of opportunity. In the event HESP is not formally approved, no obligation is placed on the U.S. government to carry any selected investigation through to completion. Confirmation of any selections made for final development for flight will be contingent on conclusion of an agreement between NASA and ISAS, which will be negotiated during the coming year.

Contractor News

NASA selected **Boeing Aerospace Co.,** Seattle, for negotiations leading to the award of a contract to provide Shuttle upper stages to place two Tracking and Data Relay Satellites—TDRS-E and TDRS-F—into geosynchronous Earth orbits.

In addition to providing Shuttle upper stage hardware, the contractor will provide engineering, support and integration of the upper stages with the satellites, and support to the cargo (the combined upper stage and satellite) integration with the Space Transportation System. The contractor also will be responsible for postflight evaluation reports.

The contract runs from March 1986 through April 1990 with a proposed price of approximately $93 million. It is anticipated the agreement will be a fixed-price-incentive contract with incentives on cost, schedule and performance. The contract will contain options for storage of the upper stages.

NASA's Goddard Space Flight Center, Greenbelt, Md., selected **Science Applications Research,** Lanham, Md., to negotiate a cost-plus-award fee contract for operations and analysis support for the National Space Science Data Center at Goddard.

The contract, will consist of a 3-year basic period of performance and a 2-year unpriced option. Additionally, a separate firm-fixed-price phase-in contract of 2 months duration will be negotiated.

The total proposed estimated cost and fees for the basic 3-year period is $10,577,000. The procurement is a consolidation of work currently performed under several contracts.

Langley Research Center Director Richard H. Peterson presents Chris Gross with a Certificate of Recognition and a monetary award for his invention of an Electronically Scanned Pressure (ESP) Sensor which replaced the mechanically scanned pressure sensor. This invention resulted in better data quality and significant cost reduction in wind tunnel pressure measurements. Since 1980 Gross has worked at Pressure Systems, Inc., a company formed and licensed by NASA to manufacture and market the system. To date Pressure Systems has sold more than 50,000 channels of ESP sensors to the major laboratories and companies of the free world.

Did You Know?

The United States Space Foundation outlined to NASA officials plans to provide a central national focal point for a variety of individual fund raising activities related to construction of a replacement orbiter for the Challenger.

The foundation is a private, non-profit, educational organization established to stimulate international dialogue on the beneficial uses of space and to integrate space education materials into the curriculum of schools at all levels.

Pursuant to its plan, the foundation has established the Challenger 7 Fund which already has received significant dollar contributions and has marshalled the support of a number of individuals and organizations. The foundation ultimately plans to donate the contributions to NASA for its use in financing a replacement orbiter should the U.S. Congress authorize a replacement.

A tenth anniversary Viking Project reunion will be held at the NASA Langley Research Center, Hampton, Va., on Saturday, July 19, 1986. For further information or reservations contact:

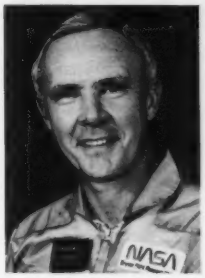
Jesse Timmons
Mail Stop 433
NASA Langley Research Center
Hampton, VA 23665
(804) 865-4621

NASA's International Ultraviolet Explorer (IUE) orbiting telescope conducted complementary observations of Comet Halley during the recent encounters of the comet by Soviet, European, and Japanese spacecraft.

The IUE telescope, which was launched in January 1978, devoted more than 250 hours of its operation to watching Comet Halley—more hours than the telescope devoted to any of its previous targets in one year.

Jack N. Nielsen, Ph.D., Chief Scientist at NASA's Ames Research Center, Mountain View, Calif., was elected to membership as one of 73 new members named by the National Academy of Engineering for 1986. He will receive his award at Academy ceremonies in October, in Washington, D.C.

Election to the Academy is considered by most engineers to be the highest professional distinction that can be conferred on an engineer. Election to membership is designed to honor individuals who have made "important contributions to engineering literature of engineering, or those who have demonstrated "unusual accomplishments in new and developing fields of technology."



Thomas C. McMurtry was appointed Chief of the NASA Ames-Dryden Flight Research Facility's Research Aircraft Operations Division.

The Research Aircraft Operations Division is responsible for operating and maintaining all aircraft assigned to the Ames-Dryden Facility. This includes research aircraft such as the X-29, the Advanced Fighter Technology Integration/F-111, an F-15 used for advanced propulsion research, and an F-14 and JetStar aircraft used for laminar flow programs, as well as F-104s and F-18s used for chase and proficiency flying.

Dr. Raymond S. Colladay, the Associate Administrator for Aeronautics and Space Technology (OAST), recently completed Harvard University's Advanced Management Program (AMP), a residential program providing a general management point of view by broadening outlooks, refining skills and knowledge, and strengthening competence in long-range policy making. Harvard's Advanced Management Program afforded Dr. Colladay the opportunity to increase his knowledge of management concepts and practices, to learn from the experiences of other high-level managers and to broaden his perspective on the interrelationships between government and private industry in research and technology efforts.

Carolyn E. Floyd, a Technical Information Specialist at the Langley Research Center, participated in the Middle Management Program for Women at Simmons College.

The program is a 10-week executive development program designed to assist employees in industry, government agencies, and the non-profit sector to prepare qualified women for positions in middle management.

Participating in the Simmons College, Middle Management Program has enhanced Ms. Floyd's capabilities in decision making, planning, budgeting, leadership, communication and supervisory skills.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans — and at a tiny percentage of the tax dollar. Here is an example:

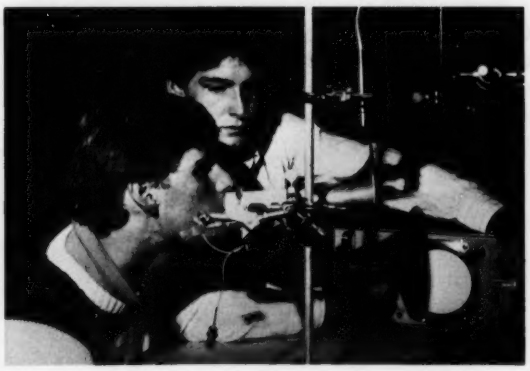
Lung Diagnosis

Disabling lung illnesses may develop from exposure to adverse occupational or environmental conditions, innate defects in the anatomy or function of the lungs, allergic responses, asthma, prolonged cigarette smoking and other conditions. Early detection, accurate diagnosis and immediate initiation of therapy improve the chances for successful treatment to forestall later stages of pulmonary illnesses. There is evident need for new, more sensitive, and more specific methods of insuring early detection of pulmonary abnormalities.

NASA research in aeroacoustics, the study of aircraft sound production toward reducing noise and vibration, has provided a theoretical basis for a mathematical-physical model of the production of human respiratory sounds, specifically "breath sounds." In theory, a particular polmonary illness causes characteristic anatomic changes or changes in the reactivity of the bronchi, and therefore of airflow through different regions of the lung. Since early changes in respiratory response to a variety of stimuli are indicators of later disease, it is imperative to develop highly sensitive methods of detecting and following the time course of such early changes.

A theory of breath sound generation based on the interactions of vortices in the pulmonary airways has been developed and validated through extensive test data acquired by Langley Research Center, Hampton, Va./ Medical College of Virginia (Richmond) researchers. The intent of the project is to develop a technique of sufficient sensitivity to break down human respiratory sounds (as these sounds are changed by dysfunction) into their spectral frequency and amplitude components. In human testing (upper right), changes in breath sounds in the pulmonary airways are recorded and analyzed by a number of complex instruments normally associated with aeroacoustic research.

The research team includes Langley aeroacoustics experts Dr. Jay C. Hardin and Dr. John M. Seiner; Dr. John L. Patterson, Jr., principal investigator, Joseph E. Levasseur, together with medical and pre-medical students and collaborating faculty of the Medical College of Virginia. The NASA-sponsored Research Triangle Institute Applications Team, Research Triangle Park, North Carolina. Bruel and Kjaer Instruments, Inc., Marlboro, Massachusetts, is supporting the project with engineering consultation and equipment. Interested in the system's commercial potential, Bruel and Kjaer predicts a market for a diagnostic and monitoring device in industrial employee check-up centers, as well as in the offices of specialists in respiratory disease, in clinics and in hospitals.



* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

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